

What is claimed is:

1. An optical imprinting apparatus comprising:
a container in which light is enclosed therein;
5 an exposure-mask having a proximity field exposure pattern
firmly fixed to a section of said container for exposing said
exposure pattern on a photo-sensitive material through an
evanescent field by said light enclosed therein; and
a light source for supplying said light in said container.
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2. An optical imprinting apparatus according to claim 1,
wherein said container comprises a waveguide, and a light source
is disposed outside of said waveguide for injecting a light into
said waveguide.
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3. An optical imprinting apparatus according to claim
1, wherein said light source is disposed inside of said container.
4. An optical imprinting apparatus according to claim
20 1, wherein said exposure-mask is provided integrally with said
container having light source therein.
5. An optical imprinting apparatus according to claim
1, wherein said exposure-mask is detachably attached to said
25 container.
6. A method for evanescent-field-assisted imprinting,
comprising:

placing a proximity field exposure pattern on a section of container in which light is enclosed;

aligning a fabrication object having a photo-sensitive film thereon in proximity of said proximity field exposure pattern;

5 and

injecting a light from said container into said proximity field exposure pattern so as to imprint said proximity field exposure pattern on said photo-sensitive material by means of an evanescent field formed between said proximity field exposure pattern and said photo-sensitive film.

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7. An exposure-mask for imprinting micro-patterns on a mask base in cooperation with an evanescent field generated by exposure light from a light source, comprising:

15 mask base being transmissive to said exposure light;

micro-patterns being comprised by high structures and low structures of sub-wavelength dimensions with respect to a wavelength of said exposure light, and

said low structures being embedded with a material of low transmissivity to said exposure light.

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8. A method for making an exposure-mask, comprising:

forming a metal thin film layer on a mask base made of a material transmissive to exposure light;

25 coating a photo-sensitive material on said metal thin film layer;

fabricating micro-patterns on said photo-sensitive material using electron beams or X-ray beams; and

irradiating with a fast atomic beam using said micro-patterns fabricated on said photo-sensitive film as exposure-mask, thereby forming micro-patterns of said metal thin film on said mask base.

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9. A method for making an exposure-mask, according to claim 8, wherein said micro-patterns have sub-wavelength dimensions with respect to a wavelength of an exposure light.

10 10. A method for imprinting micro-patterns on a substrate base, comprising:

coating not less than two coating layers, including an upper layer of a photo-sensitive film having a thickness dimension of less than a wavelength of exposure light;

15 placing an exposure-mask having proximity patterns in contact with or in proximity of said photo-sensitive film at a sub-wavelength distance so as to generate an evanescent field and expose said proximity patterns on said photo-sensitive film;

developing exposed proximity patterns by photo-processing
20 to produce a first etch-mask;

fabricating a lower coating layer on said substrate base using said first etch-mask to produce a second etch-mask comprised by said lower layer; and

fabricating proximity field exposure patterns on said
25 substrate base using said second etch-mask.

11. A method according to claim 10, wherein a thickness of said first coating layer is essentially the same as a minimum dimension of said proximity field exposure pattern.

5 12. A method according to claim 10, wherein fabrication of said substrate base or said lower layer is performed using a fast atomic beam.

10 13. A method for imprinting micro-patterns on a substrate base comprising:

applying a first coating of a photo-sensitive material on said substrate base to a thickness less than a wavelength of an exposure light;

15 placing an exposure-mask having a proximity field exposure pattern in contact with or in proximity of said proximity field exposure pattern at a sub-wavelength distance;

20 exposing said coating through said exposure-mask using said exposure light through an evanescent field and developing by photo-processing to produce first imprinted patterns on said first coating;

forming a second coating on said first imprinted pattern of said photo-sensitive material;

25 dissolving said first coating to liftoff said first imprinted patterns, thereby leaving second imprinted patterns formed by said second coating; and

fabricating said substrate base using said second imprinted patterns as etch-mask to produce micro-patterns on said substrate base.

14. A method according to claim 13, wherein a thickness of said first coating is essentially the same as a minimum dimension of said proximity field exposure pattern.

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15. A method according to claim 13, wherein fabrication of said substrate base or said first coating is performed using a fast atomic beam.

10 16. An exposure-mask for evanescent-field-assisted imprinting, comprising:

a transmissive material; and

a proximity field exposure pattern of sub-wavelength dimensions fabricated thereon, said proximity field exposure pattern being produced by imprinting a master proximity field exposure pattern provided on a mother mold.

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17. An exposure-mask according to claim 16, wherein said mother mold is a metal mold.

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18. A method for making an exposure-mask by preparing a mother mold having a proximity field exposure pattern of sub-wavelength dimensions, comprising:

pouring a transmissive material in a molten state into said mother mold; and

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cooling and detaching a solidified pattern from said mother mold, thereby producing an imprinted proximity field exposure pattern.

19. A method according to claim 18, wherein detaching from said mother mold is based on differential thermal expansion effects of materials constituting said mother mold and an
5 imprinted pattern.

20. A method according to claim 18, wherein the mother mold is pre-coated with a soluble film, which is dissolved when detaching a solidified pattern from the mother mold.
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21. A method for imprinting micro-patterns on an imprint base by preparing a pattern template having a fine structure, comprising:

coating a semi-solid material on an imprint base;
15 pressing said pattern template on said semi-solid material to produce a duplicated pattern of said fine structure; and
irradiating an energy beam on said duplicated pattern of said semi-solid material to produce said micro-patterns on said imprint base.

20 22. A method according to claim 21, wherein said fine structure comprises of high and low structures of sub-wavelength dimensions.

25 23. A method according to claim 21, wherein said pattern template is a roller having said fine-structure fabricated on an roller surface, and said fine-structure is duplicated on an imprint base by press rolling on said semi-solid material.

24. A method according to claim 21, wherein said pattern template is a flexible material disposed away from said semi-solid material on imprint base, and said template is pressed
5 by a roller to contact said semi-solid material, thereby imprinting said micro-patterns on said semi-solid material.

25. A method for imprinting micro-patterns on an imprint base by preparing a pattern template, comprising:
10 pouring a molten material on said pattern template;
cooling said molten material on said pattern template; and
detaching a solidified molten material having a duplicated pattern of said fine structure.

15 26. A method according to claim 25, wherein said fine structure comprises of high and low structures of sub-wavelength dimensions.

27. A method for fabricating micro-patterns on an imprint
20 base, comprising:
coating a photo-resist film on an imprint base;
forming a fine structure on said photo-resist film by means of electron beams or X-ray beams and developing by photo-processing to fabricate etch-mask; and
25 irradiating with a fast atomic beam through said etch-mask to produce an imprint base having said micro patterns duplicated thereon.

28. A method according to claim 27, wherein said micro patterns have sub-wavelength dimensions.

29. A method for imprinting fine patterns on an imprint
5 base for LSI devices, comprising:

preparing an exposure-mask having a fine structure of sub-wavelength dimensions; and

exposing a substrate base of a semiconductor material coated with a photo-sensitive material through said exposure-mask in
10 an evanescent field so as to imprint fine patterns on said substrate base of said LSI devices.

30. A method for imprinting micro-patterns on LSI devices, comprising:

15 preparing a pattern template having a fine structure;
pressing said pattern template on a semi-solid material coated on a substrate base of a semiconductor material so as to imprint said fine structure on a surface of said semi-solid material; and

20 etching said surface of said semiconductor material using imprinted patterns as etch-mask to fabricate said LSI devices on said semiconductor material.

31. An optical data recording medium, comprising:

25 a recording disk having a surface for containing recorded signals; and

recording pits disposed on said recording disk, said recording pits being fabricated using a method of evanescent-field-assisted fabrication.

- 5 32. An optical data recording apparatus, comprising:
a recording medium having micro-patterns of sub-wavelength dimensions with respect to signal light, having different transmissive and reflective properties;
a light source for signal light; and
10 a detection section disposed opposite to a patterned surface of said recording medium.

33. A magnetic-optical recording head, comprising:
an optical fiber having a sharpened tip of a sub-wavelength
15 dimension with respect to signal light, and
a magnetic field generation coil for magnetizing a magnetic layer disposed in proximity of said sharpened tip in association with said magnetic-optical recording head.